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Tortricid moths reared from cecidomyiid bud galls on willows

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Abstract The larvae of *Gypsonoma bifasciata* Kuznetzov and *G. hiranoi* Kawabe (Olethreutinae, Tortricidae, Lepidoptera) were observed to bore into and feed on cecidomyiid bud galls on the willow *Salix eriocarpa*. *G. bifasciata* larvae emerged from the bud galls formed by two cecidomyiid species, *Lygocecis yanagi* (Shinji) and *Rabdophaga rigidae* (Osten Sacken) (Cecidomyiidae, Diptera), while *G. hiranoi* only from a gall by *R. rigidae*. These moths were thought to hatch before the bud break and utilize the galls as an alternative food resource, since they are usually foliage feeders on young leaves.

Key words Tortricidae, facultative cecidophages, gall midges, willows, *Salix*.

Introduction

Plant galls are formed by the physiochemical interactions between plants and gall-makers. Galls are adaptive architecture that provides the gall-makers with nutritious tissues, mild microclimate and shelter from natural enemies (Price *et al*., 1987). However, galls are attractive food resources not only for gall-makers but also for other herbivores, since gall tissues generally contain more nitrogen and amino acids than normal plant tissues (McNeill & Southwood, 1977; Abe, 1995). The organisms, which feed on the tissues of galls, have been defined as cecidophages (Mani, 1964). Compared with many records of parasitoids attacking gall-makers, cecidophages have been infrequently reported.

We found that the tortricid larvae bored into and fed on the bud galls formed by gall midges on the willows. In this report, the feeding on the galls by the moths is reported and the adaptive significance of the cecidophagy was discussed in terms of alternative food resources.

Materials and methods

Gall midges

Galls are formed on various organs of plants; buds, leaves, twigs, flowers, fruits, and so on. On the willows, *Salix* spp., many insect and mite species form the galls; species in Tenthredinidae, Cecidomyiidae, Aphidae, and Epiophyidae (Yukawa & Masuda, 1996). Out of the gall-making insects, several species of Cecidomyiidae predominantly form the bud galls on *Salix* trees.

Lygocecis yanagi (Shinji) and *Rabdophaga rigidae* (Osten Sacken) (Cecidomyiidae, Diptera) have been known to form galls on buds of several *Salix* species (Salicaceae) (Yukawa & Masuda, 1996). Both species have univoltine life cycles with oviposition by gall midge adults occurring in spring, gall formation and larval development from spring to autumn, and

eclosion in the next spring (Yukawa & Masuda, 1996). The two galls are similar in appearance, but are identified by morphological characters (Yukawa & Masuda, 1996). The diameters of the galls formed by *L. yanagi* and *R. rigidae* are 4.91–10.92 mm and 6.01–13.73 mm, respectively.

Sampling procedures

On 25 March 2001, when overwintered gall midges were larvae and/or pupae in the galls, we sampled bud galls of *L. yanagi* and *R. rigidae* on three clones of the willow, *Salix eriocarpa* at the riverbank of the Kizu River (35°53′N, 135°42′E, *ca* 10 m a. s. l.) in Kyoto Prefecture, central Japan. The willow trees sampled had not yet burst their buds. We randomly cut the twigs of the willow including the bud galls. The sampled twigs were placed in plastic bags and transferred to the laboratory. Sampled galls were individually reared in the plastic bags (10 cm × 7 cm), in the laboratory under natural conditions. The moth larvae which emerged from the galls were individually reared on young *Salix* leaves until eclosion in a plastic petri dish (9 cm in diameter, 1.5 cm in height), under laboratory conditions. After almost all the gall-makers or parasitoids emerged, we also dissected the galls, which were fed on by the moths, with a utility knife and tweezers under a stereomicroscope in order to inspect whether the inside of the galls had been eaten or not.

Results and discussion

A total of 94 galls were sampled; 48 and 46 galls of *L. yanagi* and *R. rigidae*, respectively (Table 1). From only one gall (2.1%) of *L. yanagi* and three (6.5%) of *R. rigidae*, lepidopteran larvae emerged. In the galls, tissues outside the larval cell were partly grazed, and head capsules of the moths were found. These observations suggested that the hatched larvae of the moths bored into the galls and fed on the gall tissues. From the galls, which were fed on by the moths, adults of gall midges or parasitoids emerged. Therefore, the effect of the moths on the survival of the gall midges was thought to be insignificant.

The moth adults were identified as *Gypsonoma bifasciata* Kuznetzov and *G. hiranoi* Kawabe (Olethreutinae, Tortricidae). *G. bifasciata* larvae emerged from the bud galls formed by two cecidomyiid species, *L. yanagi* and *R. rigidae*, while *G. hiranoi* only from a gall of *R. rigidae* (Table 1).

Most herbivorous insects, in particular lepidopteran larvae, feed preferentially on high-quality plant tissues; young leaves with high nitrogen and water content (Scriber & Slansky, 1981). Therefore, in temperate regions, many lepidopteran caterpillars occur just after bud break (Feeny, 1970). For lepidopteran species, whose larvae feed on the young leaves, timing of

Table 1. Moths emerged from two species of cecidomyiid bud galls.

gall species		clone no. of the willow			
		clone 1	clone 2	clone 3	total
L. yanagi	sampled no.	25	10	13	48
	G. bifasciata	0	1	0	1
R. rigidae	sampled no.	7	19	20	46
	G. bifasciata	0	2	0	2
	G. hiranoi	0	1	0	1
Total		32	29	33	94

bud break is important for their developmental success; larvae hatching before bud break may starve for lack of food resources (Varley & Gradwell, 1958, 1960). If alternative food is available, larvae hatching before bud break may survive.

The adults of *G. bifasciata* and *G. hiranoi* lay eggs on the buds, and they always hatch after bud break and feed on the young leaves. In this study, *G. bifasciata* and *G. hiranoi* were observed to bore into and feed on the galls formed by gall midges on the willows. However, the percentage of the galls attacked by these moths was very low (only 4.3%). Therefore, a few larvae hatching before bud break were thought to utilize the galls as alternative food to young leaves; these two tortricid speices are facultative cecidophages.

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摘　　要

ヤナギ上のタマバエゴールから得られたハマキガ (杉浦真治・山崎一夫)

ネグロシロマダラヒメハマキ *Gypsonoma bifasciata* Kuznetzov とヒラノヒメハマキ *G. hiranoi* Kawabe (チョウ目ハマキガ科ヒメハマキ亜科) がジャヤナギ *Salix eriocarpa* 上に形成されたタマバエゴールに穿孔し摂食しているのが観察された．ネグロシロマダラヒメハマキは2種のタマバエ，ヤナギカタガワタマバエ *Lygocecis yanagi* (Shinji) およびヤナギマルタマバエ *Rabdophaga rigidae* (Osten Sacken) (ハエ目タマバエ科) によるゴールから得られ，ヒラノヒメハマキはヤナギマルタマバエのゴールのみから得られた．これらのハマキガは通常ヤナギの新葉を摂食するため，開葉前にふ化した一部の個体がゴール組織を代替食物として利用していると考えられた．

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